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| **MODULE 2 – SEQUENTIAL CIRCUITS – SOLVED TASKS**  **Practical tasks**  **Lab activity 1 : Conditional control** |
| **Objective:** Apply conditional control routines |
| A conveyor belt goes ON and OFF using a switch. The Edutrainer table moves in the forward direction if the green pushbutton is kept pressed and it moves in the backward direction if the white pushbutton is kept pressed. Table moves **only** if the conveyor belt is ON.  Note: software-based interlock must be used to protect the motor table.  **Use The Edutrainer prototype production line to implement this control task.**   1. Create an I/O assignment list.  |  |  | | --- | --- | | **Inputs** | | | Input | Address | | Switch | I4 | | Green pushbutton (N.O) | I1 | | White pushbutton (N.O) | I3 | | **Outputs** | | | Output | Address | | Conveyor belt motor | Q8 | | Table forward | Q5 | | Table backward | Q6 |  1. What is the condition in this control task?   To move the table the conveyor belt must be ON   1. Analyze the system requirements and write the Boolean expression for each output.  |  |  |  | | --- | --- | --- | | **System requirements** | | | | Output | Requirements | Boolean expression | | Conveyor belt | It goes ON and OFF using the switch (I4) |  | | Table forward | Green pushbutton is pressed and conveyor belt is moving  (interlock must be used) |  | | Table backward | White pushbutton is pressed and conveyor belt is moving  (interlock must be used) |  |  1. Draw the Ladder diagram for this control task.  |  | | --- | | untitled.bmp |  1. Use the LOGO! Soft comfort software to solve this task.   While solving this control task you are required to produce a connection table and to describe the task in the properties window.   1. Run and test the program. then fill in the table provided below by writing the status of the Edutrainer table:  * Moving forward * Moving backward * NOT moving  |  |  |  |  | | --- | --- | --- | --- | | **Conveyor belt is OFF** | | | | |  | Only green PB is kept pressed | Only white PB is kept pressed | Both green and white PBs are pressed | | Table status | Not moving | Not moving | Not moving | | **Conveyor belt is ON** | | | | | Table status | Only green PB is kept pressed | Only white PB is kept pressed | Both green and white PBs are pressed | | Table status | Moving forward | Moving backward | Not moving |  1. In the previous control task modify the ladder diagram so that the Edutrainer table can be switched OFF independently after switching OFF the conveyor belt. |

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| **Lab activity 2: Safety circuit** |
| **Objective:** Apply safety circuit concept using relay   |  |  | | --- | --- | | Relay is an electrically operated switch. Current flowing through the coil of the relay creates a magnetic field which attracts a lever and changes the switch contacts.  Your teacher will provide you by a relay as the one shown in the figure. | IMG_0509.jpg | |  | **Figure 2.16 Relay** |  1. Fill in the table provided below by writing the assigned numbers:  |  |  | | --- | --- | |  | assigned Numbers | | Normally open contacts | 5,6,7,8 | | Normally closed contacts | 1,2,3,4 | | Common contacts | 9,10,11,12 | | Coil terminals | 13,14 |  1. How many normally open contacts and normally closed contacts are provided by this relay?   4 normally open contacts and 4 normally closed contacts   1. Contact 7 can be used with contact ( 3 , 11 ) as a normally ( open , close) contact. **(Circle the correct answer)** 2. Connect the circuit as shown in figure 2.17  |  |  | | --- | --- | | IMG_0511.jpg | untitled.bmp | | **Figure 2.17 Safety circuit without load** | |  1. Press the green pushbutton and write your observation.   Relay coil goes ON and the sound indicates that N.O contacts have become closed and N.C contacts have become open contacts.   1. Press the red pushbutton and write your observation.   Relay coil goes OFF.   1. Modify the previous circuit by connecting a lamp as shown in figure 2.18  |  |  | | --- | --- | | untitled.bmp | untitled1.bmp | | **Figure 2.18 Safety circuit with load** | | |

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| Write a simple PLC program so that the lamp in the previous circuit goes ON when the green PB at the Edutrainer is pressed and it stays ON until the red PB at the Edutrainer is pressed.  Draw your program in the space provided below.   |  | | --- | | test.bmp |  1. What is the use of the relay circuit in the previous task?   It acts as a safety circuit to protect the lamp connected to the PLC.   1. Turn OFF the lamp using the emergency PB in the safety circuit. And then turn the safety circuit ON, what have you noticed? Does this comply with the safety standards?   The lamp went OFF when the emergency PB was pressed but it went ON again when the safety circuit switched ON again.  This does not comply with the safety standards since resetting the safety circuit must not result in switching-on the lamp again   1. What are the modifications should be done so that the previous safety circuit complies with the safety standards.(draw the modifications)  |  |  | | --- | --- | | untitled1.bmp | untitled1.bmp | |

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| **Lab activity 3 : Sequential control** |
| **Objective:** Apply sequential control routines |
| Use the LOGO! Soft comfort software to create and simulate the FBD shown in figure 2.14 for the grain store example, and then answer the following questions.   1. Try to turn the elevator (Q3) ON while the conveyor worm (Q1) is OFF, Is that possible?   NO, sequential start circuit is implemented.   1. Turn ON all the stages sequentially, and then try to turn OFF the first stage, is that possible?   NO, sequential stop circuit is implemented.   1. Use “Message texts” programming block to show which stage is ON.  |  | | --- | | sol.bmp | |
| **Lab activity 4 : Step sequence** |
| **Objective:** Use step sequence control routines |
| Use the LOGO! Soft comfort software and Edutrainer kit to create and test the subroutines shown below and write your comments.   |  |  |  | | --- | --- | --- | | Subroutine | Actions | Comments | | sol.bmp | Press and release I1 several times. | Every time the green PB is pressed the green light change it’s state ON to OFF and OFF to ON | | sol.bmp | Press and release I1 several times. | When the green light is ON the white light is OFF and vise versa pressing the green PB changes the state of both.  (the white light is initially ON the green is OFF) | | sol.bmp | Press and release I1 several times. | When the green light is ON the white light is OFF and vise versa pressing the green PB changes the state of both.  (both lights are initially OFF) | |